Application of probabilistic design in the failure of a dock

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Summary

The study in this text applies a probabilistic calculation, which currently takes place in offshore structures and dams, over another type of maritime structures, the gravity quays. These structures are widely used in the Spanish territory and are calculated using deterministic methods, consequently along the way a lot of useful information for the design and the supervision of the work is lost.

To incorporate the probabilistic calculation is built a programme that from the typical cross-section of the pier and the properties of the ground, verifies stability of the most relevant failures defined by the publication of the *Puertos del Estado*, ROM 0.5-05. They are used methods, formulas and criteria provided by the various "Recommendations for Marine Works" (ROM) to calculate the actions that act on the caisson and the minimum factors of safety recommended to assure the stability of the docks.

The probabilistic calculation of the pier is done via the Montecarlo method, where a large number of simulations of climatic agents and other parameters are done in order to obtain the structure behaviour in a wide range of possible scenarios. The generation of random variables depends on the probabilistic distribution that corresponds more closely to actual conduct of the variable.

Probabilistic calculation is a tool that provides a joint probability of bankruptcy and the critical points of the structure. This probability provides very useful information to decide the appropriateness of a structure depending on the activities that will be developed thanks to its construction, and balance between the costs of the work and estimated economic losses in case of bankruptcy of the pier. It is even more interesting to discover what the caisson critical points are. This information is useful to find solutions better suited or corrective measures, and establish the necessary controls to predict the failure of the structure in good time and implement the appropriate procedures that minimize the damage.

The probability obtained depends on the number of simulations conducted, so is necessary to study the convergence of the method, finding the optimal number of simulations to assure that the final outcome is representative and has sufficient precision.

This text also examines how are the cross-sections types of docks, checking the effect that could have a stone slope located immediately behind the caisson, between the concrete structure and the filling of the esplanade. The results follow a similar pattern in the two cases concerning the method of calculation, but the coupling hose necessary to make the structure stable is in each case different.

Finally the results obtained using deterministic calculation methods are compared with the probabilistic ones. The purpose of this comparison is to check if the two methods are valid for assessing the failure of a pier, and if it would be useful to develop probabilistic calculation in the design stage of the work besides that what is already being done nowadays.